



## Review on Evaluation of *Physalis peruviana* L.'s Antioxidant, Antimicrobial and Biochemical Activities

Nuri Gulesci<sup>1\*</sup>, Guzide Yücebilgic<sup>2</sup> and Ramazan Bilgin<sup>2</sup>

<sup>1</sup>Gumushane University, Gumushane Vocational School, Department of Chemistry and Chemical Processing Technologies, 29100 Gumushane, Turkey.

<sup>2</sup>University of Cukurova, Art and Science Faculty, Chemistry Department (Biochemistry Division) 01330, Balcali, Adana, Turkey.

### Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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Review Article

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### ABSTRACT

In this review, it was emphasized that natural and organic foods have a rich structure in terms of antimicrobial, antioxidant, and vitamin content. *Physalis peruviana* L., products contain minerals, amino acids, withanolides, flavonoids, and essential fatty acids, thus representing good sources of these compounds. These compounds have protective, regulatory, and nutritional roles in metabolism. *Physalis peruviana* L. is a wild fruit that has been widely used for centuries, mainly in folk medicine. The fruit and juice of *Physalis peruviana* L., contain high amounts of vitamin C, vitamin E, vitamin K1, and many other mineral substances. In addition, the ingredients in *Physalis peruviana* L., have antioxidant, antibacterial, antiviral, anti-allergic, anti-inflammatory, and antineoplastic effects. The available evidence has demonstrated the nutritional value of different products of *Physalis peruviana* L., suggesting them to be potential candidates for use in the cosmetic industry, in the preparation of functional foods, and phytomedicine for the prevention.

**Keywords:** *Physalis peruviana* L.(goldenberry); antimicrobial; antioxidant.

## 1. INTRODUCTION

With the progress of today's scientific studies, rapidly developing technology, electromagnetic fields, increasing environmental pollution and air pollution, destruction of forests, used pesticides, smoking, alcohol and drug use, ultraviolet rays, etc., factors cause harmful effects on metabolism. Along with these, ongoing living conditions increase the stress level and increase the formation of free radicals in metabolism. This radical increase in metabolism weakens the immune system and prepares the ground for the emergence of diseases. To find a solution to these factors that adversely affect human health and the diseases that occur as a result, these factors should be eliminated first. For the treatment of diseases, it is important to consume foods with natural ingredients and increase daily activities instead of using drugs.

Nutrients; are essential nutrients containing organic and inorganic chemical compounds. Apart from these features, nutrients are containing some beneficial and harmful components for metabolism. Antioxidants are at the top of these beneficial substances [1]. The use of herbal products in cancer treatment may prevent health problems that may occur relatively. The use of herbal products in cancer treatment may prevent health problems that may occur relatively. Therefore, studies on the chemical components of various plant sources used as anticancer agents have increased in recent years [2]. For example, curcumin from soybeans, polyphenols from green tea, resveratrol from grapes, lycopene from tomatoes, and crocetin from saffron are compounds that are effective in treating cancer [3-5].

### 1.1 *Physalis peruviana* L.

A golden berry is an annual plant that grows all over the world. *Physalis peruviana* L., is known as a golden berry in English speaking countries, uchuva in Colombia, cape gooseberry in South Africa, uvilla in Ecuador, ras bhari in India, aguaymanto in Peru, topotopo in Venezuela—

some of the multiple names for this fruit around the world [6]. The world's *Physalis peruviana* L. fruit cultivation area is nearly 30,622 ha and 162,386 t of yield is obtained from this area [7]. *Physalis peruviana* L. is considered an exotic fruit belonging to the Solanaceae family, such as tomatoes, potatoes, bell peppers, and peppers [8] (Fig. 1.).



**Fig. 1. *Physalis peruviana* L. [9]**

*Physalis peruviana* L. is a species of the *Physalis* genus of the Solanaceae family that grows with its various species in tropical and subtropical climate areas of the earth. It has flowers and multi-seeded fruits on the underside of its leaves. In the bowl part of the flower, which takes the form of a bag at maturity, there is grape-like fruit. *Physalis*, whose fruits are used as medicine, are also grown as ornamental plants. There are more than 70 species of the *Physalis* genus that grows naturally on earth [10]. *Physalis alkekengi*, *Physalis philadelphica*, *Physalis angulata*, and *Physalis pubescens* species grow naturally in Northern Anatolia, Southern Anatolia, and Eastern Anatolia in our country [11-13].

## 2. FUNCTIONAL PROPERTIES AND EFFECTS ON HUMAN HEALTH

The *Physalis* is sweet and contains a high level of vitamins A and C, phosphor, and iron, in addition to flavonoids, carotenoids, and functional bioactive compounds [14].

**Table 1. Water-soluble vitamin contents of *Physalis peruviana* L. fruit [15]**

Vitamin contents	Values (mg/100g DW)
Vitamin C (Ascorbic acid)	42.52± 0.34
Vitamin B <sub>3</sub> (Niacin)	3.84± 0.12
Vitamin B <sub>6</sub> (Pyridoxine)	4.59± 0.15

The methods used in the literature to determine the chemical contents of the *Physalis peruviana* L. plant and its fruit; generally, the extraction method for determining the total phenolic content; Folin Ciocalteu method determined by Singleton and Rossi [16] was used. In determining the flavonoid content, the aluminum trichloride method was studied by Zhishen *et al.* [17] and Folin-Denis methods studied by Saxena *et al.* [18] were used to determine the total amount of tannin. Besides, the methods suggested by Miller and Rice-Evans [19] and Arts *et al.* [20] were used to determine the amount of antioxidant activity. The researchers used the method proposed by Bauer *et al.* to evaluate the antibacterial activity of *Physalis peruviana* fruits [15,21].

Vitamins B or vitamin B complex corresponds to a group of vitamins that, even though they do not have chemical structural similarity, were grouped by their water-soluble character and by playing coenzyme functions at the cellular level [22].

Vitamin C: is a water-soluble compound widely found in citrus fruits and some vegetables, whose consumption is essential due to its role in the synthesis of collagen and neurotransmitters, as well as its immunomodulatory and antioxidant properties [23,24].

The data obtained in a study by Askin *et al.* [25] reported that especially the vitamin C value of *Physalis Peruviana* L. fruit is quite high and that the total phenolic and antioxidant activity amounts they detected are high, indicating that it increases the biological value of *Physalis Peruviana* L.

Antioxidants are substances that prevent the harmful effects of the cells caused by free radicals by inactivating the free radicals in metabolism and enable the cells to be repaired. Antioxidant substances prevent some tumor development in metabolism by reacting with free radicals [1].

Phenolic compounds perform their antioxidant effects by binding free radicals, forming chelates with metals, and inhibiting lipoxygenase enzymes [26].

When different studies are examined, it has been determined that *Physalis peruviana* L. has a high antioxidant capacity and has a synergistic effect with other antioxidants [24-30]. Fruits have a high

antioxidant capacity and this is caused by phenolic substances [30].

It has been widely recognized that phenolic substances in fruit juices have an important role in the antioxidant activity value, therefore, the antioxidant activity value of *Physalis peruviana* L. juice is or should be high. In many studies, antioxidant activity values of *Physalis peruviana* L. juice were determined, but different methods were preferred [19,28-32].

In similar studies, the antioxidant activity and phenolic substance content of the *Physalis peruviana* L. fruit were compared, and results showing that there was a significant correlation between these two parameters and those that did not show it was found [33-36].

Phenolic compounds are one of the most abundant chemical groups in plants. Phenolic compounds in foods affect the formation and change of taste, odor, and color of foods. In terms of the metabolism functions of these compounds, they are important in many aspects such as antioxidative and antimicrobial effects and enzyme inhibition [37].

When the nutritional elements of the *Physalis peruviana* L. fruit are examined, it draws attention to the features of high fiber content, phenolic substance, and carotenoids and therefore high antioxidant activity values. In addition to these, *Physalis peruviana* L., which is rich in fatty acid composition, is an extremely important product because they contain high amounts of vitamin C, vitamin E, vitamin K1, and many other mineral substances [26,37].

Some studies have shown that *Physalis peruviana* L. fruit has high antioxidant activity and shows a value close to the antioxidant effects of fruits such as tomatoes, peaches, apples, and carrots [38-42].

It reports that the fruits of the *Physalis peruviana* L. plant have an anti-cancer effect and that the fruit inhibits the proliferation of the lung, colon, and hepatocellular carcinoma cells where it is applied as an extract [43-45].

Phytochemical components are responsible for both pharmacological and toxic activities in plants. They are used for therapeutic purposes to treat various diseases and to heal wounds [46,47].

The flavonoids present in the table above have been reported to have antibacterial, anti-inflammatory, antiallergic, antiviral, antineoplastic, and antioxidant effects. Substances found in *Physalis peruviana* L., fruit act as free radical scavengers and metal chelators [48].

In the study conducted by El-Beltagi et al., They reported the antioxidant amount of *Physalis peruviana* fruit [15] (Table 3).

Some of the compounds found in *Physalis peruviana* fruit have strong antioxidant properties and prevent peroxidative damage to liver microsomes and hepatocytes [50,51].

Another compound, alkaloids, contributes to the survival and fitness of plant species and has pharmacological effects. It is also used as a medicine and narcotic [52,53]. The biological effects of *Physalis peruviana* L. calyx and its derivatives are shown in Table 4, as reported in the literature [54].

Table 4 presents five main biological effects of *Physalis peruviana* L. calyces reported in the literature. These are essentially sustained in the extracts of *Physalis peruviana* L. calyces in the presence of bioactive compounds such as withanolides, flavonoids, phenols, physaperuvin, saponins, and perviewis [55] possibly through the combined and synergistic actions of these and other compounds present in *Physalis peruviana* L. calyces [56].

Calyx corresponds to a structure that completely covers and surrounds the fruit and since it hangs

down it has the appearance of a Chinese lantern [57].

According to the values reported in Table 5, 30.8% of the amino acid content of *Physalis peruviana* L. pomace powder corresponded to essential amino acids, the main compound being leucine, followed by phenylalanine, threonine, and valine. Regarding nonessential amino acids, the most abundant species were glutamic, arginine, and aspartic acid. *Physalis peruviana* L. calyces contain less than 0.5% of both essential and non-essential amino acids –much lower than the proportion reported for *Physalis peruviana* L. pomace, as seen in Table 5 [58].

Campos *et al.* induced hyperlipidemia in *Mus musculus* var. swiss males and demonstrated the power of *Physalis peruviana* extract to reduce blood lipid levels.

Reyes-Beltrán *et al.* studied the effect of *Physalis peruviana* consumption on the lipid profile of patients with hypercholesterolemia during 8 weeks, detecting a decrease in serum levels of total cholesterol (9.93%) and LDL-C (14.79%).

Bernarda *et al.* reported the antibacterial action of the ethanolic extract of the *Physalis peruviana* plant and its leaves, after its application on *Listeria* spp. Cultures.

Oral administration of *Physalis peruviana* ethanolic extracts showed an increase in insulin sensitivity and a reduction of hyperglycemia in rats with type 2 diabetes-induced [59].

**Table 2. Quantitative phytochemical analysis of *Physalis peruviana* fruit [47]**

Components	Values (mg acid/g DW)	Values in ethanolic extract
Total phenols	(mg Gallic acid/g DW)	125.44±0.29
Total flavonoids	(mg Quercetin/g DW)	6.39±0.47
Total tannins	(mg Tannic acid/g DW)	14.82±0.62
Total alkaloids	DW) (g/100g	3.365± 0.006
Total anthocyanins	(µg/100g FW)	6.675±0.18
Carotenoids	(mg/100g FW)	1.53±0.06

**Table 3. Antioxidant activity of *Physalis peruviana* fruit (DPPH method) [15,49]**

Concentration (µg/ml)	DPPH % in ethanolic extract
40	58.41
80	58.53
120	64.53
150	72.83
IC <sub>50</sub> (µg/ml)	21.47

**Table 4. Biological effects of *Physalis peruviana* L. calyx and their derivatives, as reported in the literature [54]**

Outcome	Model	Dose	Results	Mechanism	Reference
Antioxidant activity	Male Wistar rats with liver inflammation induced by carbon tetrachloride (CCl <sub>4</sub> ) received an extract of <i>Physalis peruviana</i> L. calyx (orally).	10 mg mL <sup>-1</sup>	Significant inhibition of liver oxidative stress was caused by CCl <sub>4</sub> . In addition, liver steatosis was attenuated, and hepatic necrosis was avoided. Superoxide dismutase and catalase activities were close to normal.	Liver enzyme levels, increased by CCl <sub>4</sub> administration, were reduced significantly; this could be through the bioactivity of flavonoids and withanolides contained in the extract.	[55]
Antibacterial activity	<i>Physalis peruviana</i> L. calyx extract was applied to <i>Staphylococcus aureus</i> , <i>Klebsiella pneumonia</i> , and <i>Pseudomonas aeruginosa</i> cultures.	1.02–6.25µgL <sup>-1</sup>	The minimal inhibitory concentration (in gL <sup>-1</sup> ) was 1.02 and 0.26 for <i>P. Aeruginosa</i> (ethereal extract and chloroform fraction, respectively) and 1.02 for <i>K. pneumonia</i> (ethanolic fraction).	Mechanism not described.	[56]
	Methanolic extract of calyces were applied to <i>Bacillus subtilis</i> , <i>Bacillus cereus</i> , <i>Escherichia coli</i> , <i>Salmonella sp.</i> , and Yeast.	Not specified	The extract affected <i>B. subtilis</i> , <i>Salmonella sp.</i> , <i>E. coli</i> , and Yeast with inhibition zones of 27 mm, 24 mm, 24 mm, and 23 mm, respectively.	Mechanism not described; however, the observed effect might be attributed to the presence of phenols, flavonoids, xanthine, and saponins in the extract.	[57]
Skin antiaging effect	Normal human dermal fibroblast cells in culture were treated with a <i>Physalis peruviana</i> L. calyx extract.	0.02–100 mg L <sup>-1</sup>	Significant skin antiaging activity was observed at 0.5 mg L <sup>-1</sup> concentration.	Up-regulation of type I collagen, elastin, and fibrillin was seen, possibly due to epigenetic changes in DNA and/or histones through acetylation or methylation.	[58]

**Table 5. Amino acid composition of *Physalis peruviana* L. byproducts [54,57,61].**

	Amino acids	Byproducts	
		Calyx extract	Pomace powder
Non-essential (g kg <sup>-1</sup> )	Aspartic acid	4.8	78.2
	Proline	2.5	39.1
	Serine	2.3	47.3
	Glutamic acid	4.7	180.9
	Glycine	3.0	47.3
	Alanine	3.2	42.4
	Arginine	2.7	115.7
Essential (g kg <sup>-1</sup> )	Threonine	2.2	32.6
	Valine	2.9	32.6
	Isoleucine	2.1	24.4
	Leucine	3.5	58.7
	Tyrosine	1.8	31.0
	Phenylalanine	2.3	39.1
	Histidine	1.1	22.8
	Lysine	2.8	24.4
	Cystine	NR	17.9
	Methionine	NR	24.4

Briones-Labarca *et al.* developed a conventional extraction [60-64] method and a high hydrostatic pressure (HHPE) assisted extraction method for the determination of antioxidant compounds,  $\beta$ -carotene and vitamin C from gooseberry [66].

### 3. CONCLUSIONS

As a result; In scientific researches, it has been determined that *Physalis peruviana* L. acts as an antioxidant, antibacterial, anti-inflammatory, antiallergic, anti-inflammatory, antineoplastic, microbial infection, and cancer fruit for different medical purposes. It has recently made a name for itself with its taste and biological value.

It has been understood that the dried fruit and fruit juice traditionally obtained from the *Physalis peruviana* L. fruit are used for therapeutic purposes in our country and the world. I think that determining and consuming foods containing antimicrobial substances, antioxidant substances, and vitamins in their natural content will be beneficial in terms of meeting the antioxidant and vitamin needs of the metabolism, working healthier, and preventing oxidative stress. Also, natural plants and fruits that have antioxidant, antibacterial, anti-inflammatory, anti-allergic, antiviral, and similar effects should be produced as medicine.

### ETHICS APPROVAL

This article does not contain any studies done with human or animal participants performed by any of the authors.

### COMPETING INTERESTS

Authors have declared that no competing interests exist.

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